Cool, Calm and Collected:

The Buffering Effect of Head Cooling on Stress

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Abstract

Most people would like to be less stressed. With our increasingly fast paced and busy lives it appears that stress related issues are increasing, with the addition of issues such as terrorist attacks, stress at times can be hard to avoid. Many studies have found that cooling the brain is beneficial for those who have sustained traumatic brain injuries and the process of cooling can often stop or prevent further damage (Qui et al, 2006). The body may also use a natural cooling mechanism, yawning, as a way of keeping the brain at optimum temperature, so it can perform at its best (Gallup & Gallup, 2008).There seems to be very little research on the effects of head cooling on psychological variables. It was hypothesised that cooling would reduce stress levels and when put in conjunction with a self-affirmation manipulation would decrease stress levels even further. Participants had their ear temperature measured, filled out a stress questionnaire and then were asked to sit in between two fans for 12 minutes. Their ear temperature was measured again, they then went on to complete another questionnaire, some containing a self-affirmation manipulation and then went on to a stressor task. Lastly, they received a final stress questionnaire. Results were nonsignificant, yet general trends headed in the hypothesised direction. The implications of the findings are discussed as are limitations and suggestions for future research.

Introduction

We are all aware of how important the brain is, from the most basic functions, such as regulating breathing and heart rate to higher functions such as the ability to think deeply, about who we are and why we are here. For that reason it is important to keep the brain in healthy working order. Slightly cooling the brain may be one technique for promoting this healthy functioning. As discussed below, a cool brain appears to provide protective biological benefits. Largely unexplored, however, is the effect of brain cooling on psychology. This is perhaps surprising, considering the obvious, that the brain is the primary psychological organ. Given that healthy biological/physiological states are generally associated with healthy psychological states, it is possible that cooling the brain also facilitates healthy psychological states, such as reduced stress or reduced negative emotion.

From a neurological point of view cooling of the brain appears to be beneficial. It has been linked to benefits for those who have sustained Traumatic Brain Injury (TBI). Mild hypothermia (33-35˚C) is used as a therapy for head injury and is designed to reduce mortality after cardiac arrest as well as preventing brain injury from causing any further damage (Qui et al, 2006). It has also been found that mild and moderate hypothermia can alleviate secondary brain injury after TBI and that cooling has positive effects on the primary brain injury by facilitating restoration of membrane function (Qui et al, 2006).

Research on yawning also suggests that a cool brain facilitates optimal functioning. This work suggests that a variety of problematic physical and psychological problems are associated with warmer brains and that yawning is common in people with these problems

because yawning is a mechanism that cools the brain (Gallup & Gallup, 2007). For example, theorizing suggests that problems such as Multiple Sclerosis, Epilepsy, schizophrenia, headaches and stress and anxiety are associated with overheating of the brain or body (Baker & Aureli, 1997; Goldie & Green, 1961; Jacome, 2001; Postert & Pohlau, 1996; Ryan & Thakore, 2002).

In turn, these conditions are often associated with yawning (Gallup & Gallup, 2008), and it appears that yawning has physiological consequences important for cooling brain temperature. Given this, it may be that the body is trying to cool the brain through yawning. Yawning increases blood flow from the skin of the head into the cranial cavity, and this increase is essential for cooling of the brain. As more blood is pumped to the cranial cavity this allows more opportunity for heat loss through the skull (Gallup & Gallup, 2007). Experimental evidence also supports this theorizing. Gallup & Gallup, (2007) looked at incidences of contagious yawning. Participants were shown videos of people yawning and then recorded how often they yawned in response to that video. Under laboratory conditions just less than half of college students responded to contagious yawning (Gallup & Gallup, 2007). Participants were instructed to hold a warm pack, a cold pack or a pack at room temperature to their forehead and then see how often they yawned in response to the "contagious yawning video". The theory being that if their brain was already cool (e.g. from an ice pack) there would be no need for them to yawn in response to the video as the brain was already cool. Only one participant yawned in the cold pack condition, 36% of participants yawned in the hot pack condition and at room temperature 45% of participants yawned. This would support the idea that yawning is indeed a cooling mechanism. Nasal breathing and forehead cooling almost eliminated contagious yawning (Gallup & Gallup, 2007).

Brain Temperature and Psychology

Given that cooling brain temperature seems to have positive physiological consequences, and positive physiological consequences generally are associated with positive psychological states, it may be that cooling the brain facilitates positive psychological states, such as reduced stress or reduced negative emotion. Consistent with this hypothesis is work on hemispheric lateralization. Increases and decreases in cerebral blood flow are thought to be related to cerebral activation and deactivation. Cerebral blood flow is correlated with carotid blood flow (arteries that carry blood to the brain and head) and there is evidence to suggest that changes in carotid blood flow due to cerebral activation influence tympanic membrane temperature (Helton et al, 2009). Processing of negative emotional stimuli was found to be right hemisphere dominant, shown through the fact that the temperature of the tympanic membrane in the right ear was significantly higher than the temperature of the left tympanic membrane (Helton et al, 2009)

A previous study conducted by Par & Hopkins (2000) found similar results. They had chimpanzees watch negative emotional videos and again they found right tympanic membrane temperature increased. These studies provide evidence for the link between negative emotional stimuli and temperature increases.

Though we might expect cooling the brain to have beneficial psychological effect, it's possible that cooling doesn't directly reduce stress response, but does particularly well when labelled as something psychological that reduces stress. A study by Schachter & Singer (1962) illustrates this point. They manipulated participant's physiological state by giving them an injection of Epinephrine. Epinephrine commonly known as adrenalin, is a drug that is almost a perfect mimicry of discharge in the sympathetic nervous system. As a result, blood pressure increases, heart rate increases, blood flow to the muscles increases, lactic acid

increases and respiration increases slightly (Schachter & Singer, 1962). Subjective symptoms are palpitation, tremor and sometimes feelings of flushing and excelerated breathing (Schachter & Singer, 1962). The way in which we tend to interpret our physiological responses is by giving them a label in terms of cognitions available to us. For example if you felt the physiological response described above in a dark alley with a man walking towards you at night, you would likely label the physiological response as fear, given the cognitions we have about night time and dark alleys (Schachter & Singer, 1962).

If, however we do not have an obvious explanation for our physiological arousal we use whatever cognitions are available to us and in some cases from observing the reactions of people around us (Schachter & Singer, 1962). Schachter & Singer (1962) utilised this fact. Participants were injected with Epinephrine, some told exactly what to expect in terms of their reaction to the injection and some not. They then had a stooge act in a way that appeared as if they were feeling euphoric in one condition, and angry in the other. Those who had been given a label for their physiological responses (e.g. knowing it was a result of the injection) had no particular reaction to the stooge. Those in the euphoric and angry conditions, reported feelings similar to those the stooge was portraying. They didn't have an obvious explanation for their feelings so looked to the stooge as a guide. This is relevant to the current study. Assuming brain cooling causes a healthy or positive physiological state, perhaps it facilitates positive psychological states because people attribute their positive physiological state to their psychological state.

For example, Self-affirmation Theory suggests that affirming valued sources of self-worth, like valued personal qualities can buffer threats to the self, reducing their impact both physiologically and psychologically. A study looking at the threat of stress by Creswell et al, (2005) found that self-affirmation lessened participant's cortisol responses to a social stressor task. The finding that self-affirmation can buffer against stress is common across several

studies (Sherman & Cohen, 2006).If cooling facilitates positive psychological states, then perhaps it does so particularly when given a positive cognitive label, e.g., in conjunction with self-affirmation. In other words, cooling the brain in conjunction with self-affirmation may result in people labelling their physiological reactions to cooling as being feelings of psychological security and in turn may get people to feel calmer, or reduce stress.

Techniques for Cooling the Brain

There have been several ways that researchers have attempted to cool down the brain. Firstly, the human brain is thought to have three cooling mechanisms: cooling by arterial blood supply from the body, cooling by heat loss through the skull, and cooling by heat loss from the upper airways, such as the mouth and nose (Harris, Andrews & Murray, 2007).

Harris, Andrews and Murray, (2007) took advantage of this natural mechanism and looked at enhanced nasal airflow as a means of cooling the brain. Patients received unhumidified air through the nostrils at twice the rate of normal breathing. Added to the air mixture was nitric oxide gas and this was thought to aid heat loss through the nostrils (Harris, Andrews & Murray, 2007). Head fanning with two electric fans was also used, while the patients were covered in bed clothes. The greatest reduction was through nasal airflow and head fanning together. Temperature was measured using a well established technique called MRS. This uses an MRI scanner to detect certain naturally occurring metabolites in the brain. By interpreting the relative frequencies of a reference metabolite and water it is possible to determine tissue temperature (Harris, Andrews & Murray, 2007).

Further studies by Harris et al, (2008) used other methods for cooling brain temperature. Cooling was achieved using a head cooling unit which delivered air through a

hood, leaving the face exposed and a separate neck collar was worn. The hood and collar were made of a double layer of nylon with holes punched in it to allow air to flow onto the head and neck. To inhibit the body's defence against cooling foot warming was used with an MRI compatible hot pack. These were wrapped around each foot during the entire time the scanner was on. When the body begins to cool down, vasoconstriction at the periphery automatically occurs to defend against this cooling. In other words, the vasculature at the feet and hands constricts to keep the core of the body warm, allowing the feet and hands get cold Thus, the idea of these heat packs were to trick the body into thinking that it doesn't need to trigger vasoconstriction, and so to bypass the body's natural defence against cooling. In theory it would then be possible for the brain to reach lower temperatures if the body's defences had been bypassed (Holtzclaw, 2001). This study showed brain temperature can be reduced with this method producing a mean reduction of 0.37˚C after 30mins (Harris et al, 2008).

Yet another study by Qui et al, (2006) required participants to wear a "cooling cap". This cap contained water that circulated around the head at 4˚C while on the neck they wore a neck band containing blue ice straps. Selective brain cooling (cooling just the brain area) rather than whole body cooling has been shown to be the most successful way of cooling the brain as it maximises neuroprotection but minimises complications (Qui et al, 2006).

The Impacts of Stress

Stress is something that can impact everyone's life. A job interview, a public presentation or date with an attractive member of the opposite sex are all likely to create stressful responses (Taylor, 2006). Baum (1990) described stress in this way: "Stress is a negative emotional experience accompanied by predictable biochemical, physiological,

cognitive and behavioural changes that are directed either toward altering the stressful event or accommodating to its effects". Anecdotal evidence alone points to the fact that many of us are trying to create less stress in our lives and with good reason. At it's more extreme, stress can be pervasive and get in the way of healthy functioning. Social stress has been described as a major factor in the etiology of depression, anxiety and possibly even post-traumatic stress disorder. It can also have an effect on male and female reproduction, immune function and increase the likelihood of cardiovascular disease (McKittrick et al, 2009).

There are two systems involved in the stress response. The sympathetic-andrenomedullary (SAM) and the hypothalamic-pituitary-adrenocortical (HPA) axis. When an event is perceived as harmful or threatening, it is labelled so by a part of the brain called the cerebral cortex. This causes a chain of reactions. Information is transmitted from the cerebral cortex to another part of the brain the hypothalamus, This activates a response from our sympathetic nervous system. The hormones epinephrine and norepinephrine are produced from the adrenal glands and this results in a feeling of what we commonly call the "fight or flight" response, commonly resulting in higher blood pressure, heart rate, and increased sweating (Taylor, 2006).

The HPA system is also activated. The hypothalamus releases corticotrophin-releasing factor (CRF), that stimulates the pituitary gland which then produces adrenocorticotropic hormone (ACTH), stimulating the adrenal cortex to release glucocorticoids. One of these, cortisol is especially important. It helps in the conservation of carbohydrates and reduction of inflammation if injured. It also assists in calming the body to a steady state after a stressful event (Taylor, 2006). Under normal circumstances, cortisol levels will be high in the morning, peak just before lunch and decrease over the day. Chronic stress can create an imbalance in this normal rhythm where a person will experience elevated cortisol levels long into the afternoon (Taylor, 2006). From the information outlined above

we can see the possible long-term effects of stress as well as the way in which our body reacts physiologically to stress. A possible way to alleviate the effects of stress is head cooling.

The Present Study

Through the research outlined above it is easy to see the detrimental effect stress can potentially have on the body. The benefits of self-affirmation and brain cooling are also quite apparent. Cooling in relation to stress is largely unexplored. To explore this idea different cooling methods were experimented with. It was found that one of the most non-invasive and effective ways to cool participants was through the use of pedestal fans. Also, previous research by Harris, Andrews & Murray (2007) had shown this method to be effective. Given that cooling was the aim, evaporative cooling was also included through "misting" participants with water. It was thought this would mimic the effects of sweat on the skin and aid in the cooling process. In the current study we cool the head rather than the brain directly.

Various methods were considered for measuring brain temperature. An ear thermometer was an obvious choice as it was easy to administer and not too intrusive for the participant. Also, evidence suggested the tympanic membrane was an indirect, yet reliable way to measure brain temperature (Par & Hopkins, 2000). Effort was made to consult with GP's to find out what make and model they commonly use to ensure accuracy of measurement.

Self-affirmation was used as a psychological intervention as it has been shown to have positive effects on the self across a range of studies (Sherman & Cohen, 2006). Also the importance of the interplay between physiological states and psychological labels was shown

through Schachter & Singer (1962) study, providing evidence for the fact that labelling a psychological state (e.g. provided through self-affirming) could potentially influence a physiological state (the influence of head cooling on the body).

Stress was measured using a series of questionnaires asking about different aspects of the stress response, many of which were on a 9-point likert scale. This created the opportunity to get an insight into the participants' subjective experience.Participants were brought into the lab and seated. Their temperature in both ears was then taken and recorded. They were then asked to fill out a stress questionnaire. Some were then fanned for 12 minutes, while others were not fanned (still seated but fans were facing away). After the fanning temperature was taken and recorded again. All participants were given another stress questionnaire. Some received a self-affirmation manipulation along with this, while others received a self-affirmation control condition. After that all participants were given a cover story that they would be doing a mental rotation task (rotating 3D objects in the mind) and that their score was correlated with their intelligence. It was hoped this would create social stress and the desire to perform well in front of the experimenter. Added to that they were only allowed 3 minutes to answer as many questions as possible in a 3 minute period. Lastly they were given a final stress questionnaire.

We predicted that head cooling would decrease stress levels and when put in conjunction with a self-affirmation manipulation would interact to decrease stress levels even further.

Method

Participants

There were 87 participants in total, 58 females and 29 males. They were aged between 18-51 with a mean of 24.59. Participants were students from the University of Canterbury recruited via advertisements placed around campus and the UC Psychology Department's Stage One Participant Pool. Those from the participant pool received course credit for their participation, while those recruited through advertisements received a $10.00 grocery voucher for their time. They were randomly assigned to each condition and participated after giving their informed consent.

Nine participants were excluded from analyses. Of these, 7 were excluded because of procedural problems while 2 were suspicious and became wise to the true purpose of the study. Given that the cover story was designed to stress participants, knowledge of the true purpose of the study would have nullified its effect. For that reason it was necessary to exclude those people.

Design

This research was conducted using a 2 (self-affirmation/no self-affirmation) x 2 (fanning/no fanning) between groups design. The experimental condition was randomised within each sex. This was achieved by writing each of the four conditions on small pieces of paper, pulling them out of a hat and making a list of which order they came out in. This then created a list of 32 conditions in a randomised order for each gender. The participant was then matched with whichever condition on the list corresponded with their number. (e.g. Participant 1 would be paired with the first condition on the list).

Procedure

Participants were greeted and asked to take a seat in between two fans. The details of the study were explained and participants were handed a consent form and information sheet to fill in. Once filled in they were given their first questionnaire. This questionnaire was designed to get an idea of the participants' temperature preferences and also contained questions about their levels of stress. The experimenter then waited in an adjoining room until the participant had finished. Once finished, the experimenter proceeded to take the participants temperature in both ears with an ear thermometer. Participants were instructed to straighten their ear canal to help improve the accuracy of the temperature reading. Probe covers were replaced before each reading and temperatures recorded for each ear. Next it was explained they would be hooked up to the physiological equipment. They were asked to put their arms out flat on the desk, palm side up and also asked whether they were left or right handed. Fewer electrodes were attached to the arm the participant wrote with, for convenience in filling out questionnaires later in the study. Electrodes were then attached. On the participants writing arm an electrode was placed up near their elbow. On the other arm two were attached, one on the wrist and one up near the elbow opposite the electrode on their writing arm.

The experimenter then started the Biopac (heart rate) recording. First this was started for a brief period and then stopped to make sure heart rate was being recorded clearly. It was then explained that the fans would be turned on for 12 minutes to stabilise the participant's temperature. They were instructed not to move their arms as it would interfere with the heart rate recording. That was all those in the control condition (no fanning/no self-affirmation) were told. Those in the experimental condition were also told their forehead would be misted at the start, 5 minutes and 10 minutes into the fanning period and that the reason for doing so was to simulate sweating, which assists the body in stabilising temperature. Participants' who

had hair over their forehead were asked to wear a headband and told this was to expose their forehead to make misting more effective. A towel was placed over the participants arms so they didn't get too cold. Their forehead was then misted (experimental condition), the Biopac recording was started and tagged on screen. This could be done through the Biopac software to ensure the exact start point of the fanning was marked for future reference. The timer was started and the fans were turned on. The experimenter then sat in the adjoining room out of sight from the participant. In the experimental condition the experimenter would come in and spray the participant's forehead at the previously explained time intervals. The controls were left to sit in between the fans, with no interruption for 12 minutes.

Once the 12 minutes had passed, the experimenter came in and marked onscreen the endpoint of the fanning, then stopped the heart-rate recording. The towel and headband (if applicable) was removed from participants before taking ear temperature measurements. In both conditions the electrode on the hand the person wrote with was unclipped so they could freely move their arm to straighten their ear canal. Temperature measurements were then taken and recorded. It was explained that the participant would be given another form to fill out and that the idea of this one was to get a sense of their personality as it was thought different personality types might respond differently to temperature stabilisation. They were also informed that there was a questionnaire about stress on the back of that form. The experimenter then sat in the adjoining room until the participant indicated they had finished. Next the experimenter hooked the electrode on the writing arm back up to the physiological equipment. The equipment was tested to make sure it was recording properly. It was now explained that the participant would be given a task called a spatial intelligence task. They were given the cover story that the task focused on their spatial intelligence which turned out to be somewhat related to their overall intelligence and that some of the problems could be challenging but that was necessary to accurately test peoples abilities and weaknesses. The

experimenter requested the participants put a strong and concentrated effort into doing the problems so he could get some accurate feedback on their performance. It was explained they were being given the problems to see whether temperature stabilisation had an effect on how well or poorly they performed on the task and that if they were putting in a half hearted effort in it wouldn't provide useful information for the experimenter.

A computer monitor was then placed in front of the participant. The spatial intelligence problems were on a slide show (Microsoft PowerPoint) so each slide was clicked through using a computer mouse. It was explained they were to look at the object on their far left (see appendix) and that they would then see four objects that had been rotated, they were to pick the two objects they thought were the rotated version of their target object (this was also explained through pointing gestures). It was explained that they would have 3 minutes to answer as many of the questions as they could as quickly but as accurately as possible, giving their answers aloud. They were reminded not to move their arms during the task as it would interfere with the heart rate signal. The experimenter then got a timer which he placed in front of himself. He started the heart-rate recording, the timer, then clicked the mouse to start the test while informing the participant they were ready to start. The experimenter recorded the answers during the test and cycled through each problem once answered (by clicking the mouse to move to the next slide). At the end of the three minutes the participant was told it was the end of the test. The end of the heart-rate recording was marked onscreen and stopped. The monitor was shifted from in front of the participant. The clip on their writing arm was removed and they were told they would then be given a general questionnaire on demographics and that there was another questionnaire on stress. The experimenter then saved data on the computer and gathered up questionnaires in the next room.(See appendix A for full procedural script). Once the final questionnaire was completed the experimenter went on to the debriefing (see appendix B). Participants were then reimbursed for their time.

Materials and Measures

Information sheet

The information sheet provided participants with the cover story that their temperature was being stabilised in order to see if that had an effect on their performance on a spatial intelligence task. It was explained that their ear temperature would be taken, that they would be doing a set of spatial intelligence problems and that they would be connected up to equipment measuring their physiological responses. It also contained information about the length of the study (1 hour), that they would receive course credit/ $10.00 voucher for participation and that they could withdrawal at any time, including any information provided without penalty. If they chose to withdrawal the information, it would be destroyed and for those who chose to do the study, the information they gave would remain anonymous and kept confidential. They were assured that the experiment posed no harm to their physical or psychological safety, yet may produce mild feelings of stress. (see appendix C)

Consent form

The consent form required participants to confirm they had read and understood information about the study and to consent to publication of the results of the study with the knowledge their anonymity would be preserved. It also required them to confirm they understood they could withdrawal from the study at anytime (including any information they had provided) and still receive course credit/ reimbursement. (see appendix D).

Ear Temperature Chart.

This was a form with space for the number of the participant, room temperature, humidity and space to record ear temperature readings at time 1 and 2. (see appendix E)

Spatial Intelligence Task Answer Form.

This contained a table set up with numbers 1-24 representing each problem on the spatial intelligence task. Next to each number were the correct answers to each problem. This meant the experimenter could listen to each participants answers and tick whether they were right or wrong. Participants had to get both answers correct to gain a full mark. (see appendix F).

Experimental Apparatus

Two standard PC's with monitors, a stopwatch, two pedestal fans, a Hygrometer, a Welch Allyn Braun ThermoScan Pro 4000 (ear thermometer), Probe covers for ear thermometer, spray bottle, Biopac MP35 amplifier (for measuring heart rate), electrodes, headband, towel.

Questionnaires

Questionnaires were printed on A4 paper in a 12 point Garamond font. All questions were rated on a 9-point scale.

I. Stress Assessment

A series of stress questions were asked in order to measure participant's level of stress on the moment. Questions included were: "*Right now,* what is your stress level?" (*1=Not at all stressed, 9=Extremely stressed)* "*Right now*, is your stress level higher or lower than it typically is?" (*1=Lower than typical, 9=Higher than typical)* "To what extent does the level of stress you are experiencing right now feel tolerable?" (*1= Not at all tolerable, 9= Extremely tolerable)* "*Right now,* what is your level of relaxation? "(*1=Not at all relaxed, 9=Extremely relaxed)* "*Right now*, does it seem that the thoughts passing through your mind

are moving slower or faster than they typically move?"*(1=Slower than typical, 9= Faster than typical)*

Then a series of more general questions about stress were asked to indicate how easily those participants become stressed and how stressed they had been in the past couple of weeks:"Recently (over the past couple of weeks) how relaxed have you been feeling?"*(1=Not at all relaxed, 9=Extremely relaxed)*"Recently (over the past couple of weeks) how stressed have you been feeling?"(*1=Not at all stressed, 9=Extremely stressed)*"Recently (over the past couple of weeks) how quickly have you been able to relax after a stressful experience?" (*1=Not at all, 9=Very quickly)*"Do you tend to become stressed easily?"*(1=Not at all, 9=Very easily).*

II Temperature Assessment

On the back of the same questionnaire were the following temperature related questions as well as a question asking how much participants enjoyed the spatial intelligence task: "To feel comfortable, do you tend to like room temperatures warmer or cooler than other people?" *(Warmer or Cooler to circle)* "To feel comfortable, do you tend to like weather that's warmer or cooler than other people?" *(Warmer or Cooler to circle)* "If you had to choose between being slightly warm or slightly cool which would you choose?" *(Slightly warm or Slightly cool to circle).*

The following questions were also on the questionnaire, but used a 9-point Likert scale: "*Right now,* are your feet warm or cool?" (*1=Extremely cool, 9=Extremely warm)* "Are your feet *usually* warm or cool?" (*1=Extremely cool, 9=Extremely warm)* "*Right now,* are your hands warm or cool?" (*1=Extremely cool, 9=Extremely warm)* "Are your hands *usually* warm or cool?" (*1=Extremely cool, 9=Extremely warm)* "How much do you enjoy

spatial intelligence problems like the one that follows?" (with an example of one of the problems given) *(1=Not at all, 9=extremely)* (see appendix G).

Self-affirmation manipulation and "Stress Assessment 2"

The second set of questionnaires first contained a self-affirmation manipulation. This involved ranking personal characteristics in order of importance, then writing a short essay and finally rating how that essay made them feel on an emotion checklist. The first sheet titled "Ranking of Personal Characteristics and Values" contained Harber's (1995) Sources of Validation Scale and gave the following instructions:

"Below is a list of characteristics and values, some of which may be important to you, some of which may be unimportant. Please rank these values and qualities in order of their importance to you, from 1 to 11 ("1" being the most important item, "11" being the least important). Use each number only once"

The list of characteristics were: Artistic skills/Aesthetic appreciation, Sense of Humor, Relations with friends/family, Spontaneity/Living life in the moment, Social Skills, Athletics, Musical ability/appreciation, Physical attractiveness, Creativity, Business/Money, Romantic values.

They were then asked the following questions:

"What was your most important value listed on the previous page? (the value you ranked number 1)____" and "Why do you think this value might be important to you? Describe a time in your life when it has been important". There was a space of nine lines provided so participants could write their response.

Controls received an identical questionnaire but the two questions previously described were replaced by: “What was your ninth most important value listed on the previous page? (the value you ranked number 9)_____” and “Why do you think this value might be important to a typical University of Canterbury student? Describe a time in a typical student’s life when it may be important”. As with the previous questionnaire they were given nine lines to write their response.

The rating of characteristics and values was then followed by the emotion checklist titled “Emotion Checklist”. It contained the following instructions:

“We are interested in how writing the short essay (on the previous page) made you feel. The words below describe different feelings and emotions. Next to each word, rate the extent that you felt that emotion *while writing the short essay on the previous page*. Use the following scale to rate how much you felt each emotion” Rated on a 5-point scale (1= *Very slightly or not at all*, 5= *Extremely)*

There was a list of 16 emotions in which the participant was to rate using the above scale. These ranged from strong to out of control and had a series of neutral, positive and negative emotions

Both the controls and those in the experimental condition received the same emotion checklist.

Stress Assessment 2

All questions were on a 9-point Likert scale. *"Right now,* what is your stress level?" (1=*Not at all stressed, 9=Extremely stressed) "Right now,* is your stress level higher or lower than it typically is?"(1=*Lower than typical, 9=Higher than typical)* "To what extent does the level of stress you are experiencing right now feel tolerable?"(*1=Not at all tolerable, 9=Extremely tolerable) "Right now,* what is your level of relaxation?"(*1=Not at all relaxed, 9=Extremely relaxed) "Right now,* does it seem that the thoughts passing through your mind are moving slower or faster than they typically move?"(1=*Slower than typical, 9=Faster than typical) "Right now,* are your feet warm or cool?"(*1=Extremely cool, 9=Extremely warm) "Right now,* are your hands warm or cool?" (*1=Extremely cool, 9=Extremely warm)* (see appendix H) Controls received an identical questionnaire set apart from the question change on the "Sources of Validation Scale".

"Stress Assessment 3"

The final questionnaire contained the following questions:

During the spatial intelligence task, what was your stress level? (1=Not at all stressed, 9=Extremely stressed)*During the spatial intelligence task,* was your stress level higher or lower than it typically is? (1=Lower than typical, 9=Higher than typical)*During the spatial intelligence task,* to what extent did the stress you experienced feel tolerable? (1=Not at all tolerable, 9=Extremely tolerable)*During the spatial intelligence task,* what was your level of relaxation? (1=Not at all relaxed, 9=Extremely relaxed)

During the spatial intelligence task, did it seem that the thoughts passing through your mind were moving slower or faster than they typically do? (1=Slower than typical, 9=Faster than typical)How much did you enjoy doing the spatial intelligence task? (1=Not at all,

9=Extremely) *Right now,* what is your stress level?(1=Not at all stressed, 9=Extremely stressed)To what extent does the level of stress you are experiencing right now feel tolerable?(1=Not at all tolerable, 9=Extremely tolerable)*Right now,* what is your level of relaxation?(1= Not at all relaxed, 9=Extremely relaxed)How deeply/ poorly did you sleep last night?(1=Very poorly, 9=Very deeply)How high is your self-esteem/confidence today?(1=Very low, 9=Very high)

The following related question was then asked on the questionnaire: Briefly consider why this self-esteem rating might not be perfectly accurate. If you guessed again, might your self-esteem today be slightly lower or higher than this initial rating? (1=self-esteem could be slightly lower, 2= self-esteem could be slightly higher)

The questionnaire then contained a section on their demographics:

Asking their gender, age and the following questions:

What is your first language/native language?

If English is not your first language, can you please specify how long you have spoken English for? (see appendix I)

Stimuli:

As a stressor Spatial Intelligence problems were used. These were a series of mental rotation problems. There were 24 problems in total. The problems are comprised of 3D objects that the participant is to imagine turning in their mind. They first view a target object and then have to match from a series of four rotated objects, which two objects are the same as the target object they were required to turn in their mind (see appendix J)

Results

Primary Analyses

Before analysing results we excluded some participants due to suspicion of the study's true purpose and procedural difficulties (N=9).

Firstly it was important to determine whether cooling had been effective. Temperature measurements were recorded for both ears, before and after fanning. Data was analysed for the right ear first. A 2 (Self-affirmation vs No Self-affirmation) x 2 (Fanning vs No Fanning) ANCOVA was conducted with temperature after fanning as the dependent variable, controlling for baseline ear temperature. The main effect for fanning was significant. Those who were fanned (M=36.16, SD=.72) had significantly lower ear temperature than those who were not fanned. (M=37.10, SD=.37), $F(1,73)=60.23$, p=.000. The main effect for self-affirmation was not significant. Those who self-affirmed (M=36.74, SD=.59) did not have a significantly lower ear temperature than those who did not self-affirm (M=36.54, SD=.85). $F(1, 73)=2.02$, p=.160 The interaction was nonsignificant. $F(1,73)=.28$, p=.601.

The same analysis was conducted on the left ear with ear temperature after fanning as the dependent variable, again controlling for temperature at baseline. The main effect for fanning was significant. Those who were fanned (M=36.15 SD=.47) had significantly lower ear temperature than those who were not fanned (M=36.92, SD=.33). $F(1,73)=97.37$,p=.000 The main effect for self-affirmation was nonsignificant. Those who self-affirmed (M=36.55,SD=.56) did not have lower ear temperature than those who did not self-

affirm.(*M*=36.52,*SD*=.57), *F*(1,73)=.00,*p*=.983. The interaction was nonsignificant.*F*(1,73)=.076, *p*=.783.

It was hypothesised that lowering head temperature would reduce stress and that stress reduction would be particularly effective in combination with a self-affirmation manipulation when cooling is labelled as psychological security.

To test these hypotheses a series of composites were created. The first composite was made up of questions 1,2,3 and 4. This represents the dependent variable stress, taken from questions after the spatial intelligence task. Conceptually these questions were grouped together because they were all asking about the participants stress on the moment. There was then another set of composites made up of parallel questions at baseline as well as questions taken from the period after fanning but before the stressor task. The composite made it possible to examining whether the independent variables (Self-affirmation and fanning) had a direct effect on stress or only affected stress in response to a stressor. As a secondary DV another composite was created comprised of questions 7,8 and 9 (on stress assessment 3). Questions 7-9 were grouped together separately as they differed in what they were asking participants in regards to their stress level. Questions 1-4 asked after the stressor task, required participants to rate how they were feeling *during* the stressor task. Questions 7-9 asked participants to rate their stress levels *after* the stressor task. This allowed us to examine whether recovery differed as a function of condition.

Our next analysis was a 2 (Self-affirmation vs No Self-affirmation) x 2 (Fanning vs No Fanning) ANCOVA with the third stress composite (after the stressor) as the dependent variable, controlling for the parallel baseline stress composite (assessed prior to the fanning). The main effect for fanning was not significant. Those who were fanned were not significantly less stressed (*M* = 5.53 *SD* = 1.29) than those who were not fanned (*M* = 5.59,

SD = 1.22), F(1, 73)=.002, p = .963. The main effect for Self-affirmation was not significant. Those who self-affirmed were not significantly less stressed (M=5.48, SD=1.25) than those who did not self-affirm. (M=5.63, SD=1.25), F(1,73)= .653, p= .422. The interaction was not significant F (1, 73)=.075, p=.785.

The same 2-way ANCOVA was then conducted with the composite for time 2 (the period after fanning but before the stressor) as the dependent variable, again controlling for the stress baseline composite. That way we could see whether stress could be lowered without the provocation of a stressor. The main effect for fanning was not significant. Those who were fanned were not significantly less stressed (M=3.49, SD=1.03) than those who were not fanned.(M=3.82, SD=1.16) F(1,73)=1.363, p=.247. The main effect for self-affirmation was not significant. Those who self-affirmed were not significantly less stressed(M=3.58, SD=.97) than those who did not self-affirm. (M=3.72, SD=1.22), F(1,73)=1.100, p=.298.The interaction was not significant. F(1,73)=.208, p=.650.

Next we focused on our composite for our secondary stress DV, questions 7,8 and 9 discussed earlier. We wanted to see whether recovery differed as a function of condition. An ANCOVA was conducted with the stress composite 7,8 and 9 as the dependent variable, controlling for the stress baseline composite. The main effect for fanning was not significant. Those who were fanned were not significantly less stressed (M=4.03, SD=1.32) than those who were not fanned.(M=4.18, SD=1.34), F(1,73)=.134, p=.716. The main effect for self-affirmation was not significant. Those who self-affirmed were not significantly less stressed (M=3.97, SD=1.34) than those who did not self-affirm (M=4.22, SD=1.32), F (1,73)=1.483, p=.227. The interaction was not significant F(1,73)=.341, p=.561.

Secondary Exploratory Analyses

We then analyzed some exploratory variables and did a basic 2-way ANCOVA on all of them controlling for the parallel baseline question. Question 5 on "Stress Assessment 3" was analysed: "*During the spatial intelligence task,* did it seem that the thoughts passing through your mind were moving slower or faster than they typically do?". We looked at this question because it would be plausible to think that a stressed person might have racing thoughts. If the manipulations were effective in theory they should result in the lowering the speed of participants thoughts. The main effect for fanning was not significant. Those who were fanned did not have a significantly lower level of thought speed (M=5.51, SD=2.18) than those who were not fanned. (M=5.97, SD=2.21), $F(1, 73) = 1.196$, $p = .278$. The main effect for self-affirmation was not significant. Those who self-affirmed did not have a significantly lower thought speed (M=5.81, SD=2.11) than those who did not self-affirm.(M=5.68, SD=2.29), $F(1, 73) = .079$, $p = .779$. The interaction was significant. $F(1, 73) = 4.648$, $p = .034$. Pairwise comparisons showed that among those who self-affirm those who were not fanned ($M = 5.55$, $SD = 2.28$) did not have significantly lower thought speed than those who were fanned ($M = 6.12$, $SD = 1.90$), $F(1,73) = .532$, $p = .468$. Among those who did not self-affirm those who were not fanned had significantly higher thought speed ($M = 6.42$, $SD = 2.09$) than those who were fanned ($M = 6.12$, $SD = 1.90$),$F(1,73) = 5.50$, $p = .022$.

A 2-way ANCOVA was also performed on question 6 from "Stress Assessment 3": "How much did you enjoy the spatial intelligence task"? Enjoyment of the spatial intelligence task was explored because those who enjoyed the task the most, likely wouldn't have found it very stressful as it was enjoyable for those people. This would then make the stressor task not very effective which would then affect the outcome of the results. The other interesting aspect is that the manipulation performed before the stressor task may have influenced participants' level of enjoyment. The main effect for fanning was not significant. Those who were fanned did not show a significant difference in their level of enjoyment ($M = 4.16$,

SD=2.24) to those who were not fanned. (*M*=4.57, *SD*=2.09), *F*(1, 70) =.165, *p*=.686. The main effect for self-affirmation was not significant. Those who self-affirmed did not show a significant difference in their level of enjoyment (*M*=4.66, *SD*=2.03) to those who did not self-affirm.(*M*=4.10, *SD*=2.26), *F*(1, 70) =2.486, *p*=.119. However the main effect for self-affirmation did hint at significance. The interaction was not significant *F*(1, 70) =.326, *p*=.570.

Lastly an ANOVA was performed to analyse how the different groups performed on the spatial intelligence task. Both the percentage of marks correct and the raw score were used as dependent variables. No baseline measures were controlled for as it was not necessary in this case. These were explored to see whether lower stress level enhanced performance. On the spatial intelligence task, participants were required to give two answers for each question. In order to gain a full mark they had to get both answers correct. The main effect for fanning was not significant those who were fanned did not perform significantly better (*M*=4.82, *SD*=.2.53) than those who were not fanned.(*M*=5.49, *SD*=3.45), *F*(1, 74) =.962, *p*=.330. The main effect for self-affirmation was not significant. Those who self-affirmed did not perform significantly better (*M*=4.92, *SD*=2.84) than those who did not self-affirm.(*M*=5.37, *SD*=3.20), *F*(1, 74_) =.516, *p*=.475. The interaction was not significant *F*(1, 74) =.527, *p*=.470.

When the ANOVA was preformed with the percentage correct as the dependent variable again none of the results were significant. The main effect for fanning was not significant. Those who were fanned did not gain a significantly higher percentage(M=.59, SD=.26) than those who were not fanned. (*M*=.60,*SD*=.27) *F*(1, 74) =.026, *p*=.871. The main effect for self-affirmation was not significant. Those who self-affirmed did not gain a significantly higher percentage (*M*=.58, *SD*=.27) than those who did not self-affirm.(*M*=.58, *SD*=.26), *F*(1, 74) =.037, *p*=.847. The interaction was not significant *F*(1, 74) =.131, *p*=.718.

Examining Only Those Who Do Not Enjoy Spatial Rotation Questions

These same analyses were then performed again but this time excluding those people who scored higher than the midpoint on the question "How much do you enjoy spatial intelligence problems like the one that follows?". These people were excluded because, given they enjoy spatial intelligence problems to some extent, doing the task may not have been a stressor for them. In turn, if the spatial intelligence was not a stressor for these participants, then we could not adequately test the effect of cooling on buffering stress in these participants.

An ANCOVA was conducted with the stress composite at time 3 (after the stressor) as the dependent variable controlling for the parallel baseline stress composite. The main effect for fanning was not significant. Those who were fanned were not significantly less stressed (M=5.62, SD=1.34) than those who were not fanned.(M=5.77,SD=1.29), $F(1, 45) = .514$, $p = .477$. The main effect for Self-affirmation was not significant. Those who self-affirmed were not significantly less stressed (M=5.44, SD=1.35) than those who did not self-affirm.(M=5.88, SD=1.26), $F(1, 45) = .1.363$, $p = .249$. The interaction was not significant $F(1, 45) = 2.125$, p=.152.It did however hint at significance. Pairwise comparisons showed a pattern in part consistent with results. Among those who self-affirmed those who were not fanned (M=5.93, SD=1.04) had higher stress levels than those who were fanned (M=5.04, SD=1.49), p=.151 However inconsistent with the hypothesis among those who did not self-affirm, those who were not fanned (M=5.65, SD=1.50) had lower stress levels than those who were fanned (M=6.05, SD=1.07), p=.575

The same 2-way ANCOVA was then conducted with the composite for time 2 (the period after fanning but before the stressor) as the dependent variable, again controlling for

the stress baseline composite. That way we could see whether stress could be lowered without the provocation of a stressor. The main effect for fanning was not significant. Those who were fanned were not significantly less stressed(*M*=3.41, *SD*=.908) than those who were not fanned. (*M*=3.56, *SD*=1.12), *F*(1, 45) =1.345, *p*=.560. The main effect for self-affirmation was not significant. Those who self-affirmed were not significantly less stressed (*M*=3.42, *SD*= .94)than those who did not self-affirm. (*M*=3.52, *SD*=1.05), *F*(1, 45) =.560, *p*=.458.The interaction was not significant. *F*(1, 45) =1.861, *p*=.179.

Next we focused on our composite for our secondary stress DV, questions 7, 8 and 9 discussed earlier. We wanted to see whether recovery differed as a function of condition. An ANCOVA was conducted with the stress composite 7, 8 and 9 as the dependent variable, controlling for the stress baseline composite. The main effect for fanning was not significant. Those who were fanned were not significantly less stressed (4.31, SD=1.26) than those who were not fanned. (M=4.03, SD=1.45), *F*(1, 45) =.248, p=.621. The main effect for self-affirmation was not significant. Those who self-affirmed were not significantly less stressed (M=4.00, SD=1.33)than those who did not self-affirm. (M=4.33, SD=1.35), *F*(1, 45) =.682, p=.413. The interaction was not significant *F*(1, 45) =2.813, *p*=.100.However the interaction hinted at significance. Pairwise comparsions showed a pattern consistent with the hypothesis. Among those who self-affirmed those who were not fanned (*M*=4.30, *SD*=1.32) were more stressed than those who were fanned (*M*=3.75, *SD*=1.35),*p*=.428. Among those who didn't self-affirm those who were not fanned (*M*=3.81, *SD*=1.57) were less stressed than those who were fanned (*M*=4.73, *SD*=1.03),*p*=.109

We then looked at the exploratory variables previously analysed, doing a 2 way ANCOVA on all of them and controlling for their parallel baseline question. When looking at question 5 from "Stress Assessment 3" "*During the spatial intelligence task,* did it seem that the thoughts passing through your mind were moving slower or faster than they typically

do?". The main effect for fanning was not significant. The main effect for fanning was not significant. Those who were fanned did not have a significantly lower level of thought speed (M=5.61, SD=2.17) than those who were not fanned. (*M*=6.05, *SD*=2.19), *F*(1, 45) =.715, *p*=.402 the main effect for self-affirmation was not significant. Those who self-affirmed did not have a significantly lower thought speed (*M*=5.82, *SD*=2.01) than those who did not self-affirm. (*M*=5.79, *SD*=2.32), *F*(1, 45) =.010, *p*=.921. The interaction hinted at significance. *F*(1, 45) =3.044, *p*=.088. Pairwise comparisons showed a pattern that among those who self-affirmed those who were not fanned had slower thought speed (*M*=5.40, *SD*=2.27) than those who were fanned (*M*=6.17, *SD*=1.80), *F(*1,45)=.342, *p*=.562 Among those who didn't self-affirm those who were not fanned (*M*=6.58, *SD*=2.07) had faster thought speed than those who were fanned (*M*=5.19, *SD*=2.37), *F(*1,45)=3.77, *p*=.058.

We then looked at question 6 from "Stress Assessment 3": "How much did you enjoy the spatial intelligence task?" and conducted a 2 way ANCOVA controlling for the parallel baseline question. The main effect for fanning was not significant. Those who were fanned did not show a significant difference in their level of enjoyment (*M*=3.57, *SD*=2.00) to those who were not fanned. (*M*=3.55, *SD*=1.77), *F*(1, 45) =.010, *p*=.920. The main effect for self-affirmation was not significant. Those who self-affirmed did not show a significant difference in their level of enjoyment (*M*=4.00, *SD*=1.85) to those who did not self-affirm.(*M*=3.21, *SD*=1.87) However the main effect for the self-affirmation condition was approaching significance. *F*(1, 45) =3.626 *p*=.063. The interaction was not significant *F*(1, 45) =.442, *p*=.510.

Lastly an ANOVA was performed to analyse how the different groups performed on the spatial intelligence task. Again no baseline measures were controlled for as it was not necessary with this type of data. When using participants raw score as the dependent variable the main effect for fanning was not significant. Those who were fanned did not perform

significantly better (M=4.25, SD=2.08) than those who were not fanned. (*M*=5.05, *SD*=3.36) *F*(1, 46) =.954, *p*=.334. The main effect for self-affirmation was not significant. Those who self-affirmed did not perform significantly better (*M*=4.14, *SD*=2.36) than those who did not self-affirm. (*M*=4.96, *SD*=2.96), *F*(1, 45) =1.327, *p*=.255. The interaction was not significant *F*(1, 45) =.352, *p*=.556

An ANOVA was preformed with percentage correct as the dependent variable. The main effect for fanning was not significant. Those who were fanned did not gain a significantly higher percentage (*M*=.55, *SD*=.26) than those who were not fanned.(*M*=.56, *SD*=.30), *F* (1, 46) =.001, *p*=.975. The main effect for self-affirmation was not significant. Those who self-affirmed did not gain a significantly higher percentage (*M*=.52, *SD*=.27) than those who did not self-affirm. (*M*=.58, *SD*=.28), *F* (1, 46) =.758, *p*=.389. The interaction was not significant *F*(1, 46) =.080, *p*=.779.

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Discussion

Summary of Results

Results indicated that, when examining all participants, cooling the head did not decrease stress levels. Furthermore, the inclusion of a self-affirmation manipulation did not facilitate the effect of cooling on stress reduction/prevention. Results for both hypotheses were non-significant. On the whole exploratory questions yielded non-significant results also. However, several trends headed in the intended direction.

Firstly, cooling was shown to be effective in both the right and left ears of participants. Results showed a significant main effect for fanning. There was no main effect for self-affirmation but it was not expected to have any relevance to temperature readings.

In both conditions recovery did not differ as a function of condition and there were no main effects or interactions without the provocation of a stressor. Neither condition had an effect on performance level in the stressor task, however a significant main effect was hinted at in regards to self-affirmation having an effect on participants enjoyment of the stressor.

Summary of results for those who enjoyed the stressor task excluded

The same analyses were conducted for those who did not enjoy the spatial intelligence task. Enjoyment of the stressor task likely made it less effective, making the hypothesis harder to test. When the main dependent variable for stress was analysed (ratings during the stressor) there were no main effects but the interaction hinted at significance Pairwise comparisons revealed some interesting patterns. Among those who self-affirmed, those not

fanned had higher stress levels than those who were fanned. This pattern would support the hypothesis that fanning in conjunction with self-affirmation could lower stress levels. Among those who didn't self-affirm those not fanned had lower stress levels than those fanned. This lends support to the idea that self-affirmation is necessary in conjunction with fanning to have an effect. Maybe self-affirmation does provide a positive label for the physiological experiences during fanning.

Next we looked at whether recovery differed as a function of condition. Main effects were non-significant. Analyses this time produced an interaction that hinted at significance. Pairwise comparisons again revealed a pattern consistent with the hypothesis. Among those who self-affirmed those not fanned were more stressed than those fanned. This suggested recovery may be better when a participant is both fanned and self-affirms. Among those who didn't self-affirm those not fanned were less stressed than those fanned. Like the previous analysis, fanning alone appears to be ineffective, it even potentially stresses participants, but when coupled with self-affirmation, there is a pattern of lower stress levels.

Thought speed during the stressor task was the next area to be analysed. There were no main effects. The interaction hinted at significance. Those who self-affirmed but were not fanned had slower thought speeds than those who were fanned. This pattern was the same prior to exclusion of participants who enjoyed the stressor. Among those who didn't self-affirm those who were not fanned had faster thought speed than those who were fanned. This would make sense if accelerated thought speed was an indicator of stress, however the reasons and possible reactions to thought speed are quite complex, something discussed further in the next section.

The main effect for self-affirmation came very close to significance suggesting a possible pattern for self-affirmation again increasing enjoyment of the stressor task. Neither condition had any effect on performance in the stressor task.

Theoretical implications

The method of using pedestal fans and covering participants with a blanket supported the idea that fanning is an effective way of cooling head temperature. This study builds on the results found by Harris, Andrew and Murray (2007), the cooling method which this study was based on. Fanning appears to be a useful method for cooling. It may even be a useful, non-invasive way of lowering brain temperature, given Par & Hopkins (2000) point to the link between the tympanic membrane and brain temperature. However fanning alone didn't reduce stress levels. Unlike the positive benefits seen biologically from the use of fanning, those effects didn't transfer over to a psychological construct, not independently anyway.

The combination of self-affirmation and fanning showed positive signs. Effects were positive for both stress and recovery from stress. A possible explanation for this relates back to research conducted by (Schachter & Singer, 1962). If the theory behind the hypothesis for this study was correct, using self-affirmation to label physiological experiences positively assisted participants in feeling less stressed. Interestingly, fanning *and* self-affirmation were both needed to cause that effect. When not self-affirming, fanning created a pattern of stressing participants. So fanning alone didn't appear to be pleasurable. Positive effect didn't appear to be a result of the physiological experience of being cooled. Also a stressor needed to be experienced in order for these patterns to emerge. This makes sense though. It may be that high arousal is needed before we search for a label to give our physiological responses, maybe that is our need to explain and be certain of what is going on. If a response is not

alarming to us we likely don't give it much attention and therefore don't seek to give it a label. Whether a participant is labelling their physiological responses would likely be very hard to measure, it may even be unconscious but it certainly provides a possible explanation for the pattern of results.

Lowered thought speed seems positive, given that anecdotal evidence would suggest that "racing thoughts" are a common experience of someone under stress. Research conducted by Pronin & Jacobs (2008) suggests that the relationship between speed of thought and mood is quite complex. They found that in general thoughts that are fast create a positive mood, while thoughts that are slow create a negative mood. Variability of thought was also important. When fast thinking is repetitive it is more anxiety provoking. When thinking is more varied it creates an elevated mood. Fanning and self-affirmation showed a trend towards slowing thought speed during the stressor task, particularly in the case of fanning. I think this is a positive trend. During a stressor task where one has to respond at a fast rate with answers, it would be logical to assume they had speedy thought patterns. It was also likely repetitive focused thinking rather than variable, given the nature of the task. So potentially a reduction in thought speed here could be seen a sign of lowering stress levels.

Practical implications

While results only showed a pattern consistent with the hypothesis, if further research was conducted with similar results there could be potential positive implications. Given that combined fanning and self-affirmation trended towards lower stress levels and better recovery, this technique could be used to calm people after a stressful event and aid recovery. Things such as car accidents for example, as a way of soothing. It could also be used along with guided imagery in therapy settings. It may assist clients in reducing their stressful feelings, while moving through challenging thoughts in their mind. The general public could

also benefit from this technique, much like many people now meditate, this could be an alternative to meditation for those who find meditating difficult. Further research is needed before the practical implications can be truly realised.

Limitations and future directions.

As with any study, there were limitations and areas to be improved on. Sample sizes were very small. It may be that with larger sample sizes a significant result would be more likely. There is also the issue that many people in the study found the stressor enjoyable. Maybe it simply was not an effective enough stressor. If that was the case and participants were not particularly stressed, that would make it much harder to find an effect. It may be that the cover story was not particularly believable. As undergraduate students, with the majority being in their twenty's, it is quite possible many of them have done spatial intelligence problems in high school. They may have been very sceptical about their ability to measure ones intelligence. Participants were asked if they were suspicious, but not asked the question "did you believe spatial problems are indeed a measure of your overall intelligence?", quite an important question to ask in hindsight.

Given that stress and body temperature were being measured, there is no reason to think that the student population would be any different from the wider population. Even if there was variability in stress levels due to age, or other factors an effective manipulation still would have lowered stress levels. Body temperature is the same. There are differences in the mean body temperature according to age, for example. Those over the age of 60 have been shown to have lower body temperature than "normal" and have trouble maintaining optimum temperature for a variety of reasons (Lu, Leasure & Dai, 2009). However, in this case cooling is so mild temperature differences such as these are unlikely to interfere with results.

There is no reason to question the use of an ear thermometer for temperature measurements. The equipment used was the same as is used by medical doctors in New Zealand. We were looking for a mild drop in temperature, yet still wanting the temperature measurement to be of reasonable accuracy. If the same kind of thermometer is used by the medical profession to help diagnose more serious problems, using it to determine a general temperature drop should be more than adequate in this case. One possible issue could be inaccuracies in the way temperature measurements were administered e.g. how competent the experimenter was at using the equipment. The first four participants were omitted from results for that very reason. A general trend of lowered temperature was what was being sought after, complete accuracy was less important in this case. But effort was still taken (quality of equipment, practice administering) to ensure the most accurate measurement possible.

Stress response was measured using physiological equipment and self-report questionnaires. Physiological measures were not analysed as they were beyond the scope of this study. Measuring the dependent variable (stress) with the question "*Right now*, what is your stress level?" was direct and should have been an adequate measure of stress. However, there is the potential for lack of honesty among participants. Without physiological data though, this was one of the better ways of getting at the construct.

It is possible that the use of the physiological equipment made the fanning period less enjoyable and more stressful. In some of the interactions results appeared to reflect this. The fact participants were asked to sit very still for twelve minutes would be uncomfortable enough, but also having the knowledge that moving would disrupt the experimenters results

would likely put quite a pressure on participants. If the fanning period was not relaxing as it was intended to be, then that could account for the lack of significant results. In the cooling condition, misting the participants forehead at regular intervals also could have contributed to the fanning period not being as relaxing as it could have been. It likely would have been disruptive to any sense of peace, especially since getting misted isn't necessarily pleasant.

Future studies would benefit from larger sample sizes and the use of a well established method for stressing participants. The use of physiological equipment may provide extra, potentially useful data, but likely restricted participants too much to feel comfortable. It might be more useful to let participants sit and move as they please during fanning. That is likely to be more relaxing. Also excluding misting could be useful in making the fanning period more relaxing.

Conclusion

Despite the limitations and the fact results were largely non-significant, patterns were moving in the hypothesised direction. There were also many procedural difficulties that could be fine tuned and a larger sample size could reveal some more pronounced patterns. Temperature had barely been studied in relation to psychological variables, this opens up a new and interesting area to look into further. We saw how the labels we give to an artificial stressor can have an effect on our physiology, but it is even more interesting to see a pattern emerging with a naturally occurring process like temperature regulation. Further research is needed, but potentially the link between temperature and psychology could create new insights into how we function. The self-affirm/fanning method could be adapted to reduce stress for more practical uses also, as simple as a "self-help" technique for the general public, to more complex situations such helping with recovery from a traumatic/stressful event.

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Appendix A:Experimental Script.

Experiment Script

Find out which condition the participant is in.

Walk forward and shake hands.

Hi, my name is Tim Robinson and I am the researcher conducting this experiment. Please take a seat. If you have a cell phone, can you turn it off now? (*Write down temp and humidity of room on ear temp sheet)*

Right, now the purpose of this study is to see whether temperature stabilisation has an effect on your spatial intelligence. Your temperature will be stabilised by sitting in between these two fans for 12 minutes and you will be asked to fill out some questionnaires at different time points. Some are used to measure stress as we think this may be something that will get in the way of your spatial intelligence, so it's something we want to keep track of. You will also be hooked up to some physiological equipment that monitors your heart rate.That way we can see whether your self-report measures of stress match your physiological responses.

So take a look at these forms (hand information sheets/consent forms to participant). Sign them if you choose to and we will carry on into the study. I want to make it clear that any information you give me will remain private and completely anonymous. That means not me or anyone else will be able to match the answers you give with who you are and the reason for doing that is so you can answer the questions honestly without fear of being identified. So I'll give you a moment to do that.

Give temp preference questions and stress questionnaire.

Now I'm going to give you some forms to fill out, the idea of these is to get a sense of your temperature preferences. There is also a questionnaire on stress as we think it may be something that could get in the way of your spatial intelligence as I mentioned earlier. If you have any questions, just ask, in most cases instructions will be on the top of each questionnaire so should be self-explanatory.

Once signed take forms back and hook participant up to physiological equipment.

Great, Thanks for filling those out. Now I will take a baseline of your temperature in both ears. This is the same type of thermometer your GP would use so perfectly safe. If you could just hold your ear lobe up (*show them how) that would be great as* it will make it easier for me to get the thermometer in and help me get a more accurate reading. I'll just gently put this in and you let me know when it's a snug fit. Great all done. Now I will hook you up to the physiological equipment. If you could roll up your sleeves and take your watch off, if you have one that would be great, so I can attach some sensors, I'm putting these on you so I can record your heart rate, again, they're perfectly safe. Also, are you left or right handed? If you

could just rest your arms palm up, like this it will make it easier for me to attach the sensors. (*Hook them up).*

Ask Participant to take a seat between the fans, if they have long hair request they wear a headband. (remember to spray at the start and time the 12minutes).

Now I will turn the fans on so I can stabilise your temperature for 12 minutes. I will need you to remain still, but relaxed so I can get an accurate reading of your heart rate. I'll just check it is working properly. (**put timer on, spray forehead)** *Experimental condition:{* I'm also going to to spray your forehead at the start, 5 minutes and 10 minutes into the fanning period. This is so we can simulate sweating on the forehead, which assists the body in stabilising temperature. Also if you could put this headband on, it will make temperature stabilisation more effective if your forehead is exposed. (*Leave out on control).* I will also take your temperature at 12 minutes.I'll just put this towel over your arms to keep them warm. Just get comfortable, remembering not to move your arms especially, as it will muck up the signal. So i'll just set the timer, turn the fans on and push start on the physio recording, see you in 12 minutes. (turn fans on, push start on computer, push F9, type FS. End of fanning push F9 and type FE. push stop)

Stop physiological recording. Take temperature again. Hand them the stress questionnaire.

I'll just stop the physio recording. I'll also take your temperature again. So just the same as we did before. (write it down) Now I will get you to do a task designed to get an idea of your personality, as we think different personality types may respond differently to temperature stabilisation. On completing that you will also notice there is another stress questionnaire for you to fill out. **I'll unclip this wire so you can write.**

Start the spatial intelligence problems.

At this point I'm going to give you a task, called a spatial intelligence task. It focuses on your "spatial intelligence" which it turns out is somewhat related to your overall intelligence. Some of the problems can be challenging but that is necessary to accurately test people's abilities and weaknesses. So that I can get some accurate feedback on your performance I would like to ask that you put a strong and concentrated effort into doing these problems. The reason I'm giving them to you is to see whether temperature stabilisation has any influence on how well or poorly people perform on this task. So if people are only giving the task a half-hearted effort, I won't be able to get an accurate indication of how temperature stabilisation is affecting performance.(**Bring tv across)**

You will first be given a practice task, then the actual task.. Instructions will be given on the practice task, but I will also explain what you are required to do now. Take a look at the first one. You will see a series of 3D objects, 5 in total. Your job will be to look at the object on

the far left (point). There will then be four rotated objects. Your are to pick the two objects you think are the rotated version of your target object. You will be giving me your answers aloud and given a period of 3 minutes to complete them as quickly and as accurately as possible. You'll be giving me your answers aloud.I'll be recording your heart rate during the task so just remain still but relaxed like you have previously. I'll just check the equipment is working properly and start recording. (type SS push F9 at start of task, SE and F9 at the end, push stop.)I'll be marking your answers down as we go. You can start now.

(do the task) Record physiological measures during the spatial intelligence task.)

At end of the task remember to push F9 and types SE)

Hand stress questionnaire/ final questionnaire.

Great now I just need you to fill in another stress questionnaire, as well as a more general questionnaire about your age etc.

Cool. Now we can do the debriefing.

Debriefing starts.

Debriefing ends.

Once debriefing is completed save physio data as Tim 1 etc, mark down temperature of the room and humidity again. Tick off voucher sheet, plus do participant exercise/ fill out credit slip if necessary.

Appendix B: Debriefing.

Debriefing: Cool, Calm and Collected: The Buffering Effect of Head Cooling on Stress.

Experimenter: Tim Donald Robinson

Ok now I will give you a debriefing about the study as there was a bit more going on than what I said at the start. Before I do, how did you find the study?

How did you find the fanning period?

What did you think of the physiological equipment?

How did you find the spatial intelligence task?

What did you think the study was about?

I'll quickly go through some of the theories behind this study and explain exactly what the study was about.

We've been doing some theorising that mild head cooling will reduce stress. There is no direct research testing the same idea, but there is evidence pointing to the benefits of head cooling. For those with brain injury head cooling has been shown to help in the restoration of a healthy brain, and to prevent head injury from getting any worse. There is also evidence suggesting that we may use yawning as a way of cooling our brain. That is interesting because excessive yawning has been linked with headaches, stress and anxiety. So it is possible the body might use the cooling produced by yawning to protect itself against those conditions.

Our theory is that mild head cooling will reduce stress. But it's also possible that cooling the head doesn't reduce stress by itself, but only in combination with thinking in certain ways. There's a theory that our physiological responses, for example heart rate or body tension, can make us feel different emotions depending on information we have available to us in our environment. For example, if you were walking down a dark alley at night, a stranger was walking towards you and you responded with a racing heart and body tension, you would likely label that as fear, given our thoughts about dark alleys at night. If you had the same response, racing heart and body tension and you had just won lotto, you would probably label that as excitement. So the way we label our physiological state is dependent on the context we find our self in.

What we're thinking then, is that maybe cooling the head only leads to feeling less stressed if it's labelled in the right way, in a positive psychological way. Maybe cooling is a positive physiological thing, but doesn't help us feel better psychologically unless we're also thinking positively, about what we value in life, about the good parts of life. If cooling makes a person feel physiologically calm, then if they've been thinking positively, they might label the physiological calmness as psychological calmness and may feel more secure.

So, here is how we tested our idea:

Everyone sits in between the fans. Some of you sat in between them and were cooled, that was the experimental condition. Others, the controls, sat in between the fans but the fans were pointed away from the face and neck. So there shouldn't have been any cooling of the head for these people. You were in the x condition. There was no rhyme or reason as to why you were put in that condition, it was totally random.

Then all participants rated values in order of their importance and wrote a small essay. But not everyone wrote the same essay. Some of you wrote about your most important value and why that was important to you. That was designed to get people thinking positively and feeling more secure Others- the control condition- wrote about their ninth most important value and why that was important to the average student. That was designed to hopefully have no particular effect, so we could then compare those who received the self-affirmation with those who didn't.

Then, all participants went on to do the spatial intelligence task. This was designed to be hard and also to get you a little stressed. We assessed your stress level with a questionnaire, but also with sensors that monitored your heart rate and the amount you sweated on your fingers. This was so we could see if the cooling and thinking positively has any effect on stress levels during a difficult task.

Here's what we're predicting. If our theory about cooling the head is correct, then people who received the cooling should feel less stressed than those who don't receive the cooling. Or maybe, those who receive the cooling will only feel less stressed if they also write the essay that gets them to think positively.

So you can see there was more going on here than what I told you at the start. I told you I was looking at temperature stabilisation, but really I was interested in the effects of head cooling. I said that the values scale you filled out was about personality and that stress was a side issue. In fact, I was most interested in stress and the "personality measure" as I called it was designed to get you thinking positively. Lastly, I wasn't actually measuring intelligence with the spatial intelligence task. But like I mentioned, we needed a way of creating a little bit of stress, so thought that those questions would be difficult enough to do that, especially if I timed you and had you tell me the answers aloud. Had we have made the problems easy, not timed you etc, it probably wouldn't have been an effective stressor. So sorry we needed to do that, how did you find it?

The reason I didn't tell you what was really going from the start of the study was so we'd have the best chance of testing our idea. If you knew we were studying stress, you probably wouldn't feel very stressed. You also may have taken your own ideas into whether you thought things such as the positive thinking and cooling would work, which may have effected results. So does that make sense why I didn't tell you everything that was going on from the start?

We think this research could be relevant in the real world as we now live in a fast paced society where stress seems to be more of an issue than it has been in the past. For that reason

we think it is important to experiment with/ develop different techniques that could reduce stress so people are better able to cope with stress in their daily lives.

Last of all I would like to ask that you keep quiet about the true details of the study until after the semester. Given all the hard work we have put in to designing it, it would really sabotage our results if participants were to know the real details of the study prior to completing it. Can you agree to do that? Now that you know the true details of the study, are you still happy for us to use this data in our research? (Wait for response and proceed accordingly). So thanks very much for helping out, and all the best with your studies.

Appendix C: Information Sheet.

Information Sheet

Stable Performance: The Effect of Temperature Stabilisation on Spatial Intelligence.

University of Canterbury, Department of Psychology

You are invited to participate as a subject in the research project: *Stable Performance: The Effect of Temperature Stabilisation on Spatial Intelligence.*

The aim of this study is to investigate whether stabilising temperature will affect how well you perform on a spatial intelligence task.

Your involvement in this project will involve (1) Getting your ear temperature taken in both ears (This will require the experimenter to come in close contact with your head and ear). (2) Doing a series of spatial intelligence problems. (3) Being connected to equipment measuring your physiological responses (e.g. heart rate) (4) Filling out some questionnaires. The study will take approximately 1 hour and you have the right to withdraw from the project at any time, including withdrawal of any information provided. If outside the participant pool you will receive a $10.00 voucher for your time. If from the participant pool you will receive course credit.

There is no risk of suffering physical or psychological harm. The spatial intelligence will require some effort, may create mild feelings of stress and performance will vary between participants.

The results of the project may be published, but you can be assured of the complete anonymity of data gathered in this study: your identity will not be associated with any information you provide in this study (Your name will be separated from your responses in the study). Further, the data will be accessed and viewed only by the experimenter Tim Robinson and immediate supervisors.

The project is being carried out as part of a Msc degree in Psychology by Tim Robinson under the supervision of Andy Martens and William (Deak) Helton. If you have any questions or concerns please contact Tim Robinson (tdr23@uclive.ac.nz) or Andy Martens (andy.martens@canterbury.ac.nz). Please note that an Msc (the finished product of this research) is a public document via the UC library database.

The project has been *approved* by the University of Canterbury Human Ethics Committee.

Appendix D:Consent form.

Consent Form

Stable Performance: The Effect of Temperature Stabilisation on Spatial Intelligence.

University of Canterbury, Department of Psychology

I have read and understood the description of the above-titled study. I agree to participate as a subject in the study and I consent to publication of the results of the study with the understanding that anonymity will be preserved (in other words, my name will not be associated in any way with the information I provide for this study).

I understand that I may at any time withdraw from the study, including withdrawal of any information I have provided. (If you do withdraw you will still receive credit/reimbursement for your participation and you may withdraw at anytime during the study with no hard feelings)

Name (please print):

Signature:

Date:

Appendix E: Ear Temperature Chart.

Ear Temperature

Number:_____ Room temperature:_____ °C Humidity_____%

Time 1:
Right_____ Left_____
Time 2:
Right_____ Left_____

Number:_____ Room temperature:_____ °C Humidity_____%

Time 1:
Right_____ Left_____
Time 2:
Right_____ Left_____

Number:_____ Room temperature:_____°C Humidity_____%

Time 1:
Right_____ Left_____
Time 2:
Right_____ Left_____

Number:_____ Room temperature:_____°C Humidity_____%

Time 1:
Right_____ Left_____
Time 2:
Right_____ Left_____

Number:_____ Room temperature:_____°C Humidity_____%

Time 1:
Right_____ Left_____
Time 2:
Right_____ Left_____

Number:_____ Room temperature:_____°C Humidity_____%

Time 1:
Right_____ Left_____
Time 2:
Right_____ Left_____

Appendix F: Spatial Intelligence Task Answer Form.

Question	Correct Answer	Participant Answer	Verdict
1	a, c		
2	a, d		
3	b, d		
4	b, c		
5	a, c		
6	a, d		
7	b, d		
8	b, c		
9	b, d		
10	a, d		
11	c, d		
12	b, c		
13	a, b		
14	b, d		
15	b, c		
16	a, d		
17	b, d		
18	b, c		
19	a, c		
20	a, d		
21	b, d		
22	b, c		
23	a, d		
24	a, c		

Participant # _____

correct _____

Appendix G: I Stress Assessment & II Temperature Assessment.

I. Stress Assessment

Stress is a natural response that is experienced by everybody. Moreover, stress levels change from day to day, hour to hour, and even second to second, for a variety of reasons. To help us keep track of these levels and changes, for each question below please circle the answer you think most accurately represents your response.

1) *Right now,* what is your stress level?

1 2 3 4 5 6 7 8 9
Not at all stressed — Moderately stressed — Extremely stressed.

2) *Right now,* is your stress level higher or lower than it typically is?

1 2 3 4 5 6 7 8 9
Lower than typical. — Neutral — Higher than typical.

3) To what extent does the level of stress you are experiencing right now feel tolerable?

1 2 3 4 5 6 7 8 9
Not at all tolerable — Moderately tolerable — Extremely tolerable.

4) *Right now,* what is your level of relaxation?

1 2 3 4 5 6 7 8 9
Not at all relaxed — Moderately relaxed — Extremely relaxed.

5) *Right now,* does it seem that the thoughts passing through your mind are moving slower or faster than they typically move?

1 2 3 4 5 6 7 8 9
Slower than typical. — Neutral — Faster than typical.

6) Recently (over the past couple of weeks), how relaxed have you been feeling?

1 2 3 4 5 6 7 8 9
Not at all relaxed — Moderately relaxed — Extremely relaxed.

7) Recently (over the past couple of weeks), how stressed have you been feeling?

1 2 3 4 5 6 7 8 9
Not at all stressed — Moderately stressed — Extremely stressed.

8) Recently (over the past couple of weeks), how quickly have you been able to relax after a stressful experience?

1 2 3 4 5 6 7 8 9
Not at all — Moderately quickly — Very quickly

9) Do you tend to become stressed easily?

1 2 3 4 5 6 7 8 9
Not at all — Moderately — Very easily

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II. Temperature Assessment

People's preferences and attitudes about temperature vary widely. The questions below assess some of these preferences and attitudes. For each question below please circle the answer you think most accurately represents your response.

1) To feel comfortable, do you tend to like room temperatures warmer or cooler than other people?

Warmer Cooler

2) To feel comfortable, do you tend to like weather that's warmer or cooler than other people?

Warmer Cooler

3) If you had to choose between being slightly warm or slightly cool which would you choose?

Slightly warm Slightly cool

4) *Right now,* are your feet warm or cool?

1 2 3 4 5 6 7 8 9
Extremely cool. Average Extremely warm.

5) Are your feet *usually* warm or cool?

1 2 3 4 5 6 7 8 9
Extremely cool. Average Extremely warm.

6) *Right now,* are your hands warm or cool?

1 2 3 4 5 6 7 8 9
Extremely cool. Average Extremely warm.

7) Are your hands *usually* warm or cool?

1 2 3 4 5 6 7 8 9
Extremely cool. Average Extremely warm.

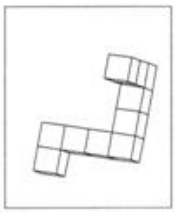
III. Spatial Intelligence Task

Below is an example of a "spatial intelligence" question. We are interested in assessing whether this kind of problem is one you find enjoyable or not. Please look it over and answer the question below.

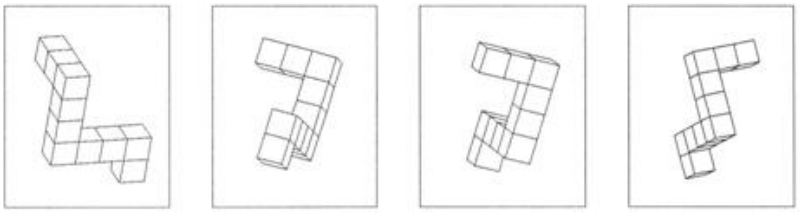
How much do you enjoy spatial intelligence problems like the one that follows?

1 2 3 4 5 6 7 8 9
Not at all Moderately Extremely

Now look at this object:
1.



Two of these four drawings show the same object.
Can you find those two? Put a big X across them.



If you marked the first and third drawings, you made the correct choice.

Ranking of Personal Characteristics and Values

Below is a list of characteristics and values, some of which may be important to you, some of which may be unimportant. Please rank these values and qualities in order of their importance to you, from 1 to 11 ("1" being the most important item, "11" being the least important). Use each number only once.

____ Artistic skills/Aesthetic appreciation
____ Sense of Humor
____ Relations with friends/family
____ Spontaneity/Living life in the moment
____ Social Skills
____ Athletics
____ Musical ability/appreciation
____ Physical attractiveness
____ Creativity
____ Business/Money
____ Romantic values

What was your most important value listed on the previous page? (the value you ranked number 1)

_____

Why do you think this value might be important to you? Describe a time in your life when it has been important.

_____

_____

_____

_____

_____

_____

_____

_____

_____

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Emotion Checklist

We are interested in how writing the short essay (on the previous page) made you feel. The words below describe different feelings and emotions. Next to each word, rate the extent that you felt that emotion *while writing the short essay on the previous page*. Use the following scale to rate how much you felt each emotion:

1	**2**	**3**	**4**	**5**
very slightly or not at all	a little	moderately	quite a bit	extremely

1. _____ strong
2. _____ connected
3. _____ empathic
4. _____ humble
5. _____ proud
6. _____ vulnerable
7. _____ superior
8. _____ powerful
9. _____ loving
10. _____ in control
11. _____ victimised
12. _____ ashamed
13. _____ inferior
14. _____ powerless
15. _____ weak
16. _____ out of control

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Stress Assessment 2

For each question below, please circle the answer you think most accurately represents your response.

1) *Right now,* what is your stress level?

1 2 3 4 5 6 7 8 9
Not at all stressed — Moderately stressed — Extremely stressed.

2) *Right now,* is your stress level higher or lower than it typically is?

1 2 3 4 5 6 7 8 9
Lower than typical. — Neutral. — Higher than typical.

3) To what extent does the level of stress you are experiencing right now feel tolerable?

1 2 3 4 5 6 7 8 9
Not at all tolerable — Moderately tolerable — Extremely tolerable.

4) *Right now,* what is your level of relaxation?

1 2 3 4 5 6 7 8 9
Not at all relaxed — Moderately relaxed — Extremely relaxed.

5) *Right now*, does it seem the thoughts are passing through your mind are moving slower or faster than they typically move?

1 2 3 4 5 6 7 8 9
Slower than typical. — Neutral. — Faster than typical.

6) *Right now,* are your feet warm or cool?

1 2 3 4 5 6 7 8 9
Extremely cool — Average — Extremely warm

7) *Right now,* are your hands warm or cool?

1 2 3 4 5 6 7 8 9
Extremely cool. — Average. — Extremely warm

Appendix I:Stress Assessment 3.

Stress Assessment 3

For each question below, please circle the answer you think most accurately represents your response.

1) *During the spatial intelligence task,* what was your stress level?

1 2 3 4 5 6 7 8 9
Not at all stressed Moderately stressed Extremely stressed.

2) *During the spatial intelligence task,* was your stress level higher or lower than it typically is?

1 2 3 4 5 6 7 8 9
Lower than typical Neutral. Higher than typical.

3) *During the spatial intelligence task,* to what extent did the stress you experienced feel tolerable?

1 2 3 4 5 6 7 8 9
Not at all tolerable Moderately tolerable Extremely tolerable

4) *During the spatial intelligence task,* what was your level of relaxation?

1 2 3 4 5 6 7 8 9
Not at all relaxed Moderately relaxed Extremely relaxed

5) *During the spatial intelligence task,* did it seem that the thoughts passing through your mind were moving slower or faster than they typically do?

1 2 3 4 5 6 7 8 9
Slower than typical. Neutral. Faster than typical.

6) How much did you enjoy doing the spatial intelligence task?

1 2 3 4 5 6 7 8 9
Not at all Moderately Extremely

7) *Right now,* what is your stress level?

1 2 3 4 5 6 7 8 9
Not at all stressed. Moderately stressed. Extremely stressed.

8) To what extent does the level of stress you are experiencing right now feel tolerable?

1 2 3 4 5 6 7 8 9
Not at all tolerable Moderately tolerable Extremely tolerable

9) *Right now,* what is your level of relaxation?

1 2 3 4 5 6 7 8 9
Not at all relaxed. Moderately relaxed. Extremely relaxed.

10) How deeply/ poorly did you sleep last night?

1 2 3 4 5 6 7 8 9
Very poorly. Moderately Very deeply.

11) How high is your self-esteem/confidence today?

1	2	3	4	5	6	7	8	9
Very low								Very high.

Briefly consider why this self-esteem rating might not be perfectly accurate. If you guessed again, might your self-esteem today be slightly lower or higher than this initial rating?

self-esteem could be slightly lower 1 2 self-esteem could be slightly higher

Demographics:

Gender: Male / Female (please circle) Age:_____

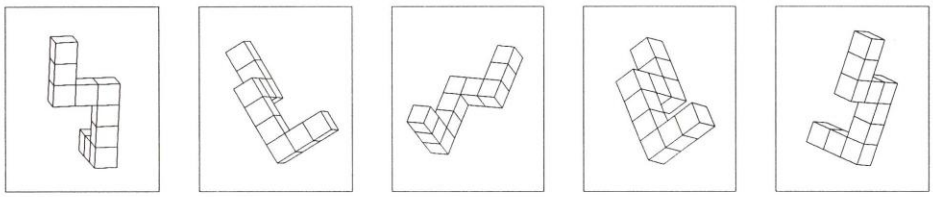
What is your first language/native language?_____
If English is not your first language, can you please specify how long you have spoken English for:_____

Appendix J: Example Spatial Intelligence problems

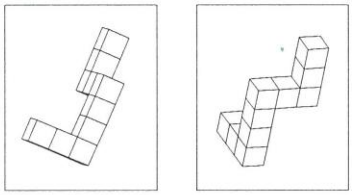
MENTAL ROTATIONS TEST (MRT-A)

This test is composed of the figures provided by Shepard and Metzler (1978), and is, essentially, an Autocad-redrawn version of the Vandenberg & Kuse MRT test.

Please look at these five figures



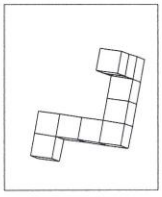
Note that these are all pictures of the same object which is shown from different angles. Try to imagine moving the object (or yourself with respect to the object), as you look from one drawing to the next.



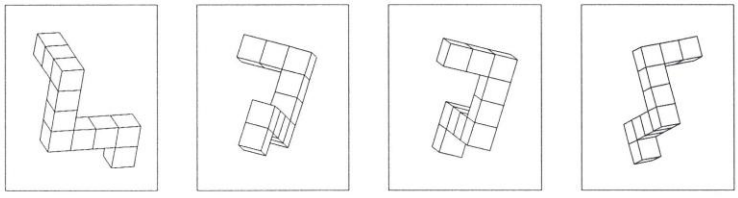
Here are two drawings of a new figure that is different from the one shown in the first 5 drawings. Satisfy yourself that these two drawings show an object that is different and cannot be "rotated" to be identical with the object shown in the first five drawings.

Now look at this object:

1.



Two of these four drawings show the same object. Can you find those two? Put a big X across them.



If you marked the first and third drawings, you made the correct choice.

Here are three more problems. Again, the target object is shown twice in each set of four alternatives from which you choose the correct ones.